What is the Grey line?

Excerpt form ON4UN's book: *Low Band DXing*

1.3.3 DUSK AND DAWN; TWILIGHT PERIODS

The terminator, mentioned before, is only an imaginary dividing line between one half of the earth in daylight and the other half in darkness. Visual transition from day to night and vice versa happens quite abruptly in the equatorial zones, and very slowly in the polar zones (see Section 1.1.3.1). The so-called *gray line* is a gray band between day and night, usually referred to as the twilight zone. Dusk and dawn periods produce very interesting propagation conditions which are not limited to the lower HF frequencies.

Long before sunrise there is no D-layer activity above or in the western direction from a particular station location. Hence, there is no absorption at all (situation A in Figure 1.7). Later, as the earth rotates, we come to situation B, where the gradual build-up of the D layer commences at the transmitter site. Initially the density of ionization is rather low, and arriving signals will be refracted rather than absorbed. This phenomenon can lower the effective angle of radiation as seen from the reflecting E layer. This results in a longer single-hop distance or in a greater signal strength for a given number of hops. This is one of the reasons why DX signals always peak during the dusk and dawn periods over all E-W, NE-SW and NW-SE paths. This does not apply to N-S paths.

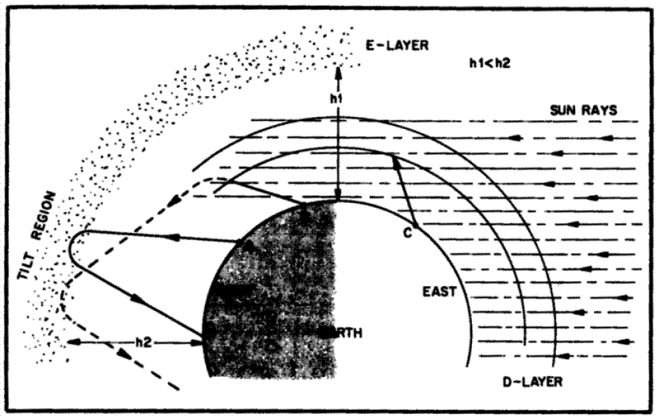

Figure 1.7—At sunrise signals are refracted slightly by the D layer which is only marginally ionized, and then refracted back to earth in the E layer. Due to the tilt in the E layer in the region where night changes into day, a further lowering of the effective radiation angle occurs.

In addition, the ionosphere, responsible for the refraction of the low-band signals, is changing abruptly in height at sunrise/sunset time. This effective ionospheric tilt helps to create the necessary conditions for trapped-wave or chordal-hop propagation (see further in this Section).

There is another reason why we seem to be able to work DX much better during these twilight periods. When the sun is rising in the morning, all signals coming from the east (which can often cause a great deal of QRM during the night) are greatly attenuated by the D layer existing in the east. The net result is often a much quieter band from one direction (east in the morning and west in the evening), resulting in a much better signal-to-noise ratio on weak signals.

It is also of utmost importance to know how long these special propagation conditions exist; in other words how long the effects of the radio-twilight periods last. To understand the mechanism, it should be clear that the rate of D-layer build-up depends upon the rate of sunrise, or in other words the height of the sun at local noon. There are two factors that determine this rate: The season (the sun rises faster in summer than in winter) and the latitude of your location (the sun rises very high near the equator, and culminates in low angles near the poles).

The effect of advantageous propagation conditions at sunrise and sunset has been recognized since the early days of low-band DXing. It was Dale Hoppe, K6UA and Peter Dalton, W6NLZ who called the zone in which the special propagation conditions exist the *gray line* (Ref 108). The gray line is a zone centered around the geographical terminator. It should be clear from the above explanation that the effective width of the zone is certainly not constant over its total circumference, and will actually depend on the speed of sunrise. This means we have a narrow gray line near the equator, and a wide gray line near the poles. The time span during which we will benefit from typical gray-line conditions will accordingly be short near the equator and long in the polar regions. This means that the gray-line phenomenon is much less important to the low-band DXer living in equatorial regions than to his colleague close to the polar circles. We should not forget, however, that a total propagation path consists of two terminal points and a long stretch in between. Propagation is not only determined by circumstances at the two terminal points.

It is not clear whether propagation proper inside the gray line along the terminator benefits from its existence. It is clear, however, that signal launching at the transmit and receive end does benefit greatly from the mechanism.